APPENDIX F

MOTOR VEHICLES IDLING EMISSION ESTIMATES

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This appendix provides an overview of the vehicle classes potentially impacted by the Proposed ATCM. It also includes an estimate of pollutant emissions resulting from unnecessary general idling and primary engine idling during prolonged rest periods. Further, this chapter provides estimates of the emission reductions expected from implementing the Proposed ATCM.

A. Estimation of Vehicle Idling Emissions

Affected Vehicles

The focus of the Proposed ATCM is the reduction of unnecessary idling of commercial and publicly owned diesel-fueled commercial motor vehicles with a gross vehicular weight rating (GVWR) greater than 10,000 pounds. The heavy-duty diesel vehicle classification can be segregated into heavy, heavy-duty diesel vehicles (HHDDV) (GVWR greater than 33,000 pounds), medium heavy-duty diesel vehicles (MHDDV) (GVWR between 14,001 and 32,999 pounds) and light heavy duty diesel vehicles (LHDT-2) (GVWR between 10,000 and 14,000 pounds). Examples of vehicles affected include, but are not limited to delivery trucks, trash trucks, bulk hauling trucks, cargo tankers, utility trucks, tour and urban buses, and construction vehicles.

The Proposed ATCM does not apply to motor homes. Motor homes typically use on-board generator sets to provide electrical power when the vehicle is parked for any length of time to save fuel and reduce noise and vibration. Therefore, the primary diesel engine is not normally used while the motor home is parked. School bus idling is already regulated under the "Airborne Toxic Control Measure to Limit School Bus Idling and Idling at Schools."

The population of heavy-duty vehicles ranges widely in age from new model year vehicles to pre-1975 vehicles. Trucks used for interstate commerce tend to be much newer (post 1994) due to the demands placed on the vehicle from extensive travel. Many of these vehicles are equipped with sleeper berths that include ancillary devices such as computers, televisions, and microwave ovens to provide driver comfort and safety during federally mandated rest periods. It should be noted that sleeper berths are assumed to be installed only on trucks classified as HHDDVs, but not all HHDDVs are so equipped.

Number of Affected Vehicles in California

The estimated vehicle populations operating in California that will be affected by the Proposed ATCM were obtained from EMFAC2002 v2.2 (EMFAC2002) and are as follows:

Table F-1

Projected Vehicle Population Distribution

	2000	2005	2009
HHDDV	157,877	179,838	196,534
MHDDV	149,452	177,598	195,767
LHDV-2	15,143	36,263	16,816
Buses*	33,496	15,562	37,963
Total	355,968	409,261	447,080

*excluding school buses

These vehicle populations include both in-State and out-of-State vehicles operating in California. According to EMFAC 2002, the out-of-state population accounts for about 25 percent or roughly 102,000 (based on 2005 projections), of all such vehicles in California. Of these, approximately 67,000 typically idle for extended rest periods in California each day. Staff assumed California registered sleepers would typically be used for interstate commerce outside of California and therefore any emissions contribution would be negligible. Table F-2 presents the portion of the aforementioned total population that idle the primary engine during prolonged driver rest periods.

Table F-2

Total Projected Daily Sleeper Population

2000	2005	2009
58,467	67,221	73,432

Estimated 2005 Vehicle Idling Times

Heavy-duty diesel vehicles in California operate a significant amount of the time at idle. Based on data collected using global positioning satellite data loggers (Battelle, 1999; JFA, 2002) and information obtained from a report by the United States Department of Energy (Stodolsky et al., 2000), staff estimated average unnecessary general idling times. A summary of unnecessary idling times by class are presented in Table F-3.

Table F-3

Average Unnecessary Idling Times by Affected Vehicle Class

Vehicle Class	Average Unnecessary General Idling Times
HHDDV	0.7 hour per day
MHDDV	0.3 hour per day
LHDT-2	0.0 hour per day
Bus	0.3 hour per day

The data listed in Table F-3 reflects only the unnecessary idling that will be addressed under the Proposed ATCM and does not include idling time for sleeper extended idling. Sleeper idling is addressed later in this appendix.

The reasons for general vehicle idling vary greatly. Drivers often operate their engines at idle to provide cab climate control, to keep the engine oil warm to avoid cold-start problems during winter months, to produce electrical power to operate appliances, or simply out of habit. According to a pilot survey on truck idling trends conducted in Northern California, the majority of the drivers run their engines at idle mainly for heating (67 percent) or air conditioning (83 percent) purposes (Brodrick et al., 2001). It should be noted that some drivers operate both heating and air conditioning during the course of a day due to changing weather conditions.

Estimated 2005 General Vehicle Idling Emissions

To establish baseline emissions (i.e., emissions prior to the reductions anticipated from the Proposed ATCM), staff segregated emission estimates into four major categories: HHDDV, MHDDV, LHDT-2, and tour/urban buses (buses). The following illustrates how vehicle idling emissions for 2005 were developed.

Table F-4 presents the average fleet emission factors used for the different vehicle categories in estimating 2005 emissions. Staff conservatively assumed that general idling emissions occurred when vehicles were not necessarily (on average) operating heaters, air conditioners, or ancillary equipment. Therefore, staff applied emission factors obtained when the engines were not under any load. The emission factors were used along with the 2005 population and the average unnecessary idling time for each vehicle category to calculate emissions. These emissions are summarized in Table F-5 and are estimated to be 208 tons per year (tpy) of PM in 2005. NOx emissions from unnecessary general idling were estimated to be 6,573 tpy in 2005.

Table F-4

Idle Emission Factors without Accessory Load

Category -Year	PM (g/hr)	NOx (g/hr)
LHDT-2-2005	1.74	80.7
All Others-2005	2.82	88.9

Table F-5

Unnecessary General Idling Emissions for 2005

Category	Population	hr/day Idling	PM (tpy)	NOx (tpy)
HHDDV	179,838	0.7	143	4,501
MHDDV	177,598	0.3	60	1,905
LHDT-2	36,263	0.0	0	0
Buses	15,562	0.3	5	167
Total	409,261		208	6,573

Estimated 2005 Sleeper Idling Emissions Methodology

Data on the number of in-State and out-of-State trucks that idle during prolonged rest periods in California are not readily available. Through utilization of California DMV, Caltrans, and internal survey data, staff estimated that approximately 67,000 sleepers may operate in California during any given day.

In this Staff Report: Initial Statement of Reasons, truck and rest stop parking spaces are referred to as designated spaces. Other areas typically used for extended rest periods include highway off ramps, public streets, and locations at or near distribution points. These are referred to in this Staff Report: Initial Statement of Reasons, as undesignated spaces. To estimate emissions from trucks parked at designated and undesignated spaces, two approaches were developed and are described below.

Designated Spaces

To estimate the number of trucks parked at designated spaces. Staff assumed that some reduction of idling emissions from prolonged rest periods would occur through the use of on- and off-board truck stop electrification devices (TSE). Based on staff's estimate of TSE development progress, staff assumed that about 10 percent of the available designated parking spaces would be equipped with TSE by 2009 and adjusted the data accordingly.

Using growth trends from EMFAC2002, the ARB staff estimated that between 5 and 10 percent of the 2009 HHDDVs would be certified to the 2007 federal on-road emission standards. To account for these trucks, the parking space data was further adjusted by 5 and by 10 percent, producing two scenarios to reflect the high and low range in the emission calculations.

Staff also developed estimates of idling times for trucks parked in designated spaces. In order to provide a reasonable range of likely idling times, two additional scenarios were developed to model the average amount of time that a truck would idle while parked at a designated space. The first scenario used data from an unpublished truck stop marketing survey by a leading manufacturer of TSE devices that found that while parked, the trucks idled for 90 percent of the time. In the second scenario, staff used

the results of a survey of a northern California truck stop conducted by ARB staff that indicated that the trucks idled for 70 percent of the time.

Staff next estimated the number of hours per day that a given designated space would be occupied by a truck. Staff also considered that a designated space may be used by a number of different trucks throughout a 24 hour period. Using additional data from the unpublished truck stop marketing survey mentioned above, staff estimated the weighted average daily designated space utilization to be 78 percent, or 18.59 hours per day. Because of recent changes in the federal hours of service requirements that will increase the required number of hours per day that drivers must be off-highway, staff increased the estimate of designated space utilization to 20 hours per day.

Assuming trucks equipped with sleeper berths use the truck engine to power air conditioners, heaters, and ancillary equipment while idling, staff used the high idle with accessory load emission factors from Table C-3 of the staff report for "Public Hearing to Consider the Adoption of Heavy-Duty Vehicle Idling Emission Reduction Requirements," (ARB, 2003). Those emission factors are presented in Table F-6 below. Emission factors for the years 1998-2006 were chosen to reflect that trucks equipped with sleeper berths tend to be newer.

Table F-6

High Idle Emission Factors with Accessory Load for On-Road Heavy-Duty Diesel Vehicles

Model Year Group	PM (g/hr)	NOx (g/hr)
1998-2002	2.77	165
2003-2006	2.77	165
2007-2010	0.28	165
2010 - Newer	0.28	165

Annual emissions from trucks using designated parking spaces were then calculated using the estimates of the number of spaces, the hours per day of utilization, the percent of the utilization time spent idling, and the emission factors from Table F-6.

Undesignated Spaces

Staff also calculated the emissions from trucks equipped with sleeper berths parked at undesignated spaces or locations outside of truck stops and rest stops. Based on a study at Argonne National Laboratory (Argonne), the average truck idled for about 6 hours per day for purposes of rest or sleep. Because of recent changes in the federal hours of service requirements that increased the number of required off-highway hours per day, staff increased this value to 8 hours per day for our estimates. Pollutant emissions from trucks idling at undesignated parking spaces were then estimated based on the number of undesignated parking spaces occupied, the hours of idling per day, and the pollutant emission factors from Table F-6.

Estimated General and Sleeper Category Idling Emissions

Table F-7 presents the estimated emissions from sleepers for the years 2000, 2005, and 2009.

Table F-7

Emissions from Prolonged Idling During Driver Rests (without ATCM Implementation)

Idling Emissions (tons per year)

Year	Average Diesel PM	NOx
2000	268	12,590
2005	230	13,699
2009	253	16,103

The total combined general and sleeper projected statewide diesel PM and NOx emissions from years 2000, 2005 and 2009 are included in Table F-8. These estimates include new engine standards and turnover in the vehicle population, but do not include the projected additional reductions expected from implementation of the Proposed ATCM. Expected emission reductions from the implementation of the Proposed ATCM are discussed later in this appendix.

Table F-8

Idling Emission Estimates from Effected Categories (without ATCM Implementation)

Idling Emissions (tons per year)

Year	Diesel PM	NOx
2000	503	17,488
2005	438	20,272
2009	418	23,994

Table F-8 shows that prolonged vehicle idling during driver rest periods contributes a significant portion of idling emissions in California. Though population-wise this category is 16 percent of the total number of trucks operating in the State, primary engine idling from extended driver rest periods comprises over 50 percent and approximately 70 percent of the total diesel PM and NOx emissions, respectively.

B. Estimation of Vehicle Idling Emission Reductions from the Proposed ATCM

Emission reductions are expected to occur in two phases. The first phase will result in the elimination of general unnecessary idling of commercial and publicly owned diesel-fueled motor vehicles with a GVWR of greater than 10,000 pounds and will be effective immediately upon adoption of the Proposed ATCM into State law. The second phase

requires trucks that idle during extensive rest periods to limit idling of the main engine. This provision becomes effective in January 1, 2009.

Phase One – Limiting Unnecessary General Idling

From the established idling times presented in Table F-3, staff calculated that with the general five (5) minute limit in place, the average unnecessary idling times would be reduced as presented in Table F-9 below.

Table F-9

Average Reduced Unnecessary Idling Times by Affected Vehicle Class

Vehicle Class	Average Reduced Unnecessary General Idling Times per Vehicle
HHDDV	0.6 hour per day
MHDDV	0.2 hour per day
LHDT-2	0.0 hour per day
Bus	0.2 hour per day

Table F-10 presents estimated emission reductions from the implementation of Phase One of the Proposed ATCM.

Table F-10

Estimated Reduced Unnecessary General Idling Emissions for 2005

Category	Population	hr/day Idling	PM (tpy)	NOx (tpy)
HHDDV	179,838	0.6	122	3,858
MHDDV	177,598	0.2	40	1,269
LHDT-2	36,263	0.0	0	0
Buses	15,562	0.2	4	111
Total	409,261		166	5,238

Staff estimates that emission reductions starting in 2005 would be approximately 166 tpy of diesel PM and 5,238 tpy of NOx. The PM emission benefits of the Proposed ATCM are expected to decrease over time relative to 2005 levels because the population of older, higher emitting heavy-duty diesel vehicle engines will decrease and the population of newer engines that meet more stringent emission standards will increase.

Phase Two - Limiting Engine Idling During Extended Rest Periods

To estimate the emission reductions from Phase two of the Proposed ATCM, staff assumed that the Proposed ATCM would limit all idling emissions from trucks parked at both designated and undesignated spaces. Further, staff assumed that after the

January 2009 implementation date of Phase Two of the Proposed ATCM, trucks parked for extended rest periods would use auxiliary power systems (APS) that use a small diesel engine to provide power for heating, air conditioning, and on-board appliances. This approach represents a very conservative estimate of the emission reductions expected from implementation of Phase two of the Proposed ATCM. Under this scenario, emission reductions achieved by restricting primary engine idling during extended rest periods will be offset to a small extent by additional emissions generated by APS use. Staff's calculations assume that APS emissions would essentially replace the primary engine idling emissions from all vehicles.

Emission factors for APS systems are presented in Table F-11. These emission factors do not represent new emission limits to be proposed by Staff in 2005. Emission factors contained in Table F-11 are based on established or proposed new engine emission standards for small off-road engines.

Table F-11

Emission Factors for Auxiliary Power Systems (<11 hp)

Year	PM (g/hr)	NOx (g/hr)
1995-1999	3.8	63
Tier I (2000-2004)	3.2	41
Tier II (2005-2007)	2.5	29
Tier IV (2008)	1.3	29

Staff also took under consideration that the Proposed ATCM requires that at the time of installation, the APS is to be certified to the more stringent of California or federal standards for newly manufactured off-road or nonroad engines.

Estimated emission reductions from implementation of Phase two are listed in Table F-12.

Table F-12

Emission Reductions from Prolonged Idling During Driver Rest (ATCM Implementation)

Idling Emissions (tons per year)

Year	Average Diesel PM	NOx
2009	134	12,338

The total combined general and sleeper population projected statewide reductions of diesel PM and NOx emissions from years 2000, 2005 and 2009 are included in Table F-13.

Table F-13

Idling Emissions Reduction Estimates from Affected Categories (ATCM Implementation)

Idling Emissions (tons per year)

Year	Diesel PM	NOx
2000	-	-
2005	166	5,239
2009	266	18,626

The resulting estimated emission reductions equate to an overall 37 and 64 percent diesel PM reduction for years 2005 and 2009, respectively. NOx is similarly reduced by 26 and 78 percent.